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# CALCULUS.

215. Proposed by PROFESSOR B. F. FINKEL, A. M., 4038 Locust Street, Philadelphia, Pa.

Prove that, if the differential equation  $cydx - (y + a + bx)dy - nx(xdy - ydx) = 0$ , be transformed into an equation between  $u$  and  $x$  by the substitution  $u(y + a + bx + nx^2) = y(c + nx)$ , then the variables are separable; and reduce the equation to the form  $dv/\phi(v) = dx/\phi(x)$  by the further substitution  $v = au + \beta$ ,  $a$  and  $\beta$  being suitably determined. *Euler*. [Forsyth's *Differential Equations*, p. 48, Ex. 4.]

Solution by W. J. GREENSTREET, M. A., Editor of The Mathematical Gazette, Stroud, England.

The first equation may be written

$$\frac{dy}{dx} = \frac{(c + nx)y}{y + a + bx + nx^2}. \quad \text{Thus } \frac{dy}{dx} = u,$$

and as  $u(y + a + bx + nx^2) = (c + nx)y$ , we have by differentiating with respect to  $x$ , writing  $u$  for  $\frac{dy}{dx}$ , and  $\frac{u(a + bx + nx^2)}{c + nx - u}$  for  $y$ , and re-arranging,

$$\frac{du}{[c^2 - bc + na + u(b - 2c) + u^2]} = \frac{dx}{(a + bx + nx^2)(c + nx)}.$$

This is of the form  $\frac{du}{f(u)} = \frac{dx}{\phi(x)}$ .

Let  $u = c + nv$ , then  $du = ndv$ ,  $f(u) = n(a + bv + nv^2)(c + nv)$ . Hence,

$$\frac{dv}{(a + bv + nv^2)(c + nv)} = \frac{dx}{(a + bx + nx^2)(c + nx)}$$

which is of the form  $\frac{dv}{\phi(v)} = \frac{dx}{\phi(x)}$ .

Also solved by W. W. Landis, and G. B. M. Zerr.

# DIOPHANTINE ANALYSIS.

132. Proposed by O. E. GLENN, Ph. D., Springfield, Mo.

Disregarding the order of  $\lambda$ ,  $\mu$ ,  $\nu$ , how many sets of solutions has the congruence  $\lambda + \mu + \nu \equiv 0 \pmod{p-1}$  ( $p$  prime)? [A. E. Western.]

\*Solution by the PROPOSER.

Let  $n_i$  be the number of solutions in which  $i$  of the numbers  $\lambda$ ,  $\mu$ ,  $\nu$  are equal. If  $p \equiv 1 \pmod{3}$   $n_3 = 3$ , the solutions being

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\*See problems for solution, *Diophantine Analysis*, No. 134.